REVIEWS.

Art. XVI.—*On Disorders of the Cerebral Circulation; and on the Connection between Affections of the Brain and Diseases of the Heart.* By George Burrows, M.D., &c. &c. 8vo. pp. 220. London, 1846.

This volume forms an interesting and very valuable contribution to pathology. Without laying any pretension to the character of a complete treatise on the subjects discussed, the author has, in the first three of the sections into which the work is divided, presented views in relation to the peculiarities of the circulation within the cranium, and to the effects of alterations of vascular pressure within that cavity on the functions of the brain, which are calculated to throw much light upon cerebral affections generally; while, in his application of these views to the elucidation of the proximate cause of apoplexy and other comatose affections, he has done much towards removing the errors into which many of the most distinguished of our modern pathologists and therapeutists have fallen in regard to the nature and treatment of an all-important class of diseases.

In the four remaining sections Dr. Burrows directs attention to the frequent connection which exists between affections of the brain and nervous system and structural diseases of the heart. In this portion of the work numerous facts and considerations are adduced calculated to improve our acquaintance with the true pathological character and proper management of many of these nervous affections, the actual cause of which has heretofore been involved in obscurity, while their treatment has, in consequence, been empirical and often highly injudicious.

The mass of the materials of which the volume before us is composed, formed the substance of the Lumleian Lectures, delivered by the author in the months of February and March, 1843 and 1844. The first series of which lectures were published in the London Medical Gazette, for May, 1843. The present work is not, however, a mere transcript of these lectures. A considerable amount of new matter of a very interesting character has been introduced, as well as several cases bearing upon the pathological doctrines maintained in the different sections. The observations, also, on the treatment of apoplexy and hemiplegia, as well as those upon the treatment of acute affections of the heart accompanied with symptoms of nervous irritation have been extended considerably beyond the limits to which they were confined in the lectures delivered before the college of physicians.

To the volume is appended six coloured drawings, exhibiting the relative degrees of congestion of the vessels of the head, both external and internal, in animals destroyed by hemorrhage and by strangulation; by prussic acid, and then suspended, the one by the ears, the other by the hind legs; and by strangulation, the one being immediately suspended by the ears, and the other laid upon its side.

The first section treats of the cerebral circulation—in reference more especially to the modifications the circulation in the brain is capable of undergoing in health and disease; and as to how far the central organ of the circulation, the heart, when its circulating powers are increased or diminished, is capable of disturbing the functions of the brain, and in what manner these changes in the circulation affect the brain.

Our readers are all aware that many modern physicians of very high standing in the profession have, from experiments, and from reasonings founded on the mechanical construction of the cranium, arrived at the conclusion, that the absolute quantity of blood within the cranium is at all times very nearly the same.

The adoption of this opinion by most of the medical writers of Great Britain is, in a great measure, owing we suspect to the authority of Dr. Abercrombie, in whose work on the Diseases of the Brain and Spinal Marrow, it is inculcated as being founded upon a series of experiments performed by Dr. Kellie, as well as upon the peculiar construction of the cranium.

Dr. Burrows presents an analysis of some of the experiments of Dr. Kellie, and shows how very little evidence they afford in support of the general inferences he has drawn from them,—namely,

> "1. That a state of bloodlessness is not discovered in the brains of animals which have died by hemorrhage; but on the contrary, very commonly a state of venous cerebral congestion.
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> "2. That the quantity of blood in the cerebral vessels is not affected by gravitation, or posture of the head.
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> "3. That the congestion of the cerebral vessels is not found in those instances where it might be most expected; as in persons who die by hanging, strangulation, suffocation, &c.
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> "4. That if there be repletion or depletion of one set of vessels (arteries or veins), in the cranium, there will be an opposite condition of the other set of vessels."

After pointing out the direct opposition which exists between the conclusions to be drawn from the experiments of Dr. Kellie, according to his own admissions, and the assertion made by him in a subsequent communication to the Medico-Chirurgical Society of Edinburgh, "that in the ordinary state of the parts, we cannot lessen to any considerable extent, the quantity of blood within the cranium by arteriotomy or venesection;" whereas, if the skull of an animal be trephined, then hemorrhage will leave very little blood in the brain; Dr. Burrows proceeds to detail a series of experiments performed by himself by bleeding animals to death, and comparing the state of the cerebral blood-vessels in them and in animals which had died from other causes.

> "On the 11th of January, 1843, I killed," remarks Dr. B., "two well-grown rabbits. The one (A, Plate I.) by opening the jugular vein and carotid artery on one side of the throat, the other (B, Plate II.) was strangled. Each animal died violently convulsed. A ligature was drawn tightly round the throat of the rabbit A immediately it expired, to prevent any further escape of blood from the vessels of the head. The rabbits were allowed to remain twenty-four hours on a table, resting on their sides. While the blood was flowing from the rabbit A, the conjunctiva was observed to become pallid, and the eyeballs to shrink within the sockets. Upon the examination of the head of this rabbit, the integuments and muscles appeared blanched and exsanguined. Upon removing the upper portions of the cranium, the membranes of the brain were found pallid, and scarcely the trace of a blood-vessel was to be detected on the surface of the brain. The longitudinal and lateral sinuses were nearly empty of blood, and their course was not denoted by any colour of blood. Upon making sections of the brain, the interior appeared equally exsanguined.
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> "Soon after the cord was drawn tight round the throat of the rabbit B, the conjunctival vessels became congested, the eyeballs turgid, prominent, and even projecting beyond the margin of their sockets. The integuments and muscles of the

head were found full of blood. Upon opening the cranium, the superficial vessels of the membranes, as well as the sinuses, were full of dark liquid blood. The whole substance of this brain, and its membranes, appeared of a dark reddish hue, as if stained by extravasated blood. The contrast between the two brains in point of vascularity, both on the surface and in the interior, was most striking. In the one scarcely the trace of a blood-vessel was to be seen; in the other every vessel was turgid with blood."

These experiments were repeated with similar results.

Dr. Burrows remarks that he has found the brains of sheep, slaughtered by butchers, much less depleted than the brains of rabbits which have died of hemorrhage. "But," he remarks, "these sheep did not die from simple loss of blood; but partly from division of the pneumonic nerves and cervical portion of the spinal cord, which lesions no doubt influenced the appearances."

In a tabular view of the principal pathological appearances met with in 72 insane patients examined at Bethlem Hospital by Mr. Lawrence, it appears that in 53 the vessels of the brain were found congested; sometimes turgid, at others extremely turgid,—and upon one occasion, Mr. Lawrence reported that he had never seen the blood-vessels of the brain and its membranes more injected with blood.

"Among the whole number, the cerebral vessels were found exsanguined—'unusually empty'—only once, and in this case death was caused by hemorrhage from the bursting of a femoral aneurism three days prior to the fatal event. When we learn," remarks Dr. B., "that in the autopsies of 72 insane patients, the cerebral vessels were found unusually empty, only once, and that this patient bled to death from the bursting of an aneurism, can we give credence to the statement, that the quantity of blood in the cerebral vessels is always nearly the same, or, that artificial abstraction of blood does not diminish the actual quantity in the cerebral vessels? Hence," remarks Dr. B., "it is not a fallacy, as some suppose, to assert that bleeding diminishes the actual quantity of blood in the cerebral vessels. By abstraction of blood we not only diminish the momentum of blood in the cerebral arteries, and the quantity supplied to the brain in a given time, but we actually diminish the quantity of blood in the vessels."

In order to ascertain, so far as such an experiment can do, the effect of the gravitation of the blood upon the vessels of the brain, Dr. B. destroyed by prussic acid two full-grown rabbits—

"And while their hearts were still pulsating, the one (C, Plate III.) was suspended by the ears, the other (D, Plate IV.) by the hind legs. They were left suspended for twenty-four hours; and before they were taken down for examination, a tight ligature was placed around the throat of each rabbit, to prevent as effectually as was possible, any further flow of blood to or from the head, after they were removed from their respective positions.

"In the rabbit C, the whole of the external parts of the head, the ears, the eyeballs, &c., were pallid and flaccid,—the muscles of the scalp and bones of the cranium were also remarkably exsanguined. Upon opening the cranium, the membranes and substance of the brain were pallid, the sinuses and other vessels were exsanguined; anemic beyond expectation. In the rabbit D, the external parts of the head, the ears, eyeballs, &c., were turgid, livid, and congested. The muscles and bones of the cranium were of a dark hue, and gorged with blood, which at some parts appeared extravasated. Upon opening the cranium, the membranes and vessels were dark and turgid with liquid blood; the superficial veins were prominent, the longitudinal and lateral sinuses were gorged with dark blood, and there was staining of the tissues, if not extravasation of blood into the membranes. The substance of the brain was uniformly dark, and congested to a remarkable extent.

"From the foregoing experiments it would appear, that the principle of the subsidence of fluids after death, operates on the parts contained within the cranium, as well as upon those situated in the thorax or abdomen.

> "The discovery," remarks Dr. B., "of the operation of this force on the blood within the cranium after death, suggests a precaution very essential to be followed, when it is desired to ascertain the precise amount of congestion of the cerebral vessels at the time of death. In such cases a ligature should be placed around the throat of the corpse, and drawn sufficiently tight to compress the cervical vessels, and arrest all flow of blood through them. This precaution will be most required in the examination of bodies, where from the kind of death, the blood may be suspected to remain fluid in the heart and great blood-vessels. The depending or elevated position of the head during the examination of the body will not then induce deceptive appearances, which mislead us in our conclusions as to the previous amount of congestion of the cerebral vessels."

In the brains of those who have died from hanging, Dr. B. admits, that frequently the vessels will be found neither congested nor overloaded with blood, and he attempts to account for this fact from the circumstance of the pressure of the rope not always being such as to completely obstruct the return of blood through the external jugular vein on the one side, although it has effectually stopped the current on the other—and from the subsidence of the *fluid* blood after death, while the body is yet suspended, through the cervical vessels which are not completely obliterated by the pressure of the cord, and through the vertebral sinuses, and spinal plexus of nerves which are scarcely if at all affected by the compression of the rope.

> "The true state of the cerebral vessels in the bodies of those who have died by hanging, is often," remarks Dr. B., "incorrectly estimated, from the anxiety to examine the lesions produced by the compression of the rope on the larynx and trachea, as well as the condition of the heart and lungs. In making such examinations all the great vessels of the neck are usually cut across, and the thoracic organs removed from the body before the head is examined. While the head is elevated during the operation of removing the skull cap and examining the brain, the *fluid* blood gravitates from the cranium, and pours from the divided cervical vessels into the chest, and then, to the surprise of the by-standers, 'the sinuses of the dura mater, and the larger veins on the surfaces, are found but moderately filled,' or 'do not appear unnaturally full.'"

In relation to the position, that when there is repletion or depletion of one set of vessels (arteries or veins) in the cranium, there will always be an opposite condition of the other set of vessels, while the total amount of blood within the cranium will be unaltered, Dr. B., while he admits the probability of an occasional disturbance in the equilibrium between the quantities of blood in the arterial and venous systems of the brain, and that such disturbance is productive of many serious cerebral symptoms, still presumes that, even in these cases, there is also a change in the absolute quantity of blood within the cranium, and not a mere change in the relative quantities in the two systems of vessels.

Dr. B. regards the extravascular serum which exists in the ventricles, membranes, and substance of the brain as an important element of the contents of the cranium—and he admits that the whole contents of the cranium, that is, the brain, the blood, and this serum together, must be at all times nearly a constant quantity.

> "But variations in the quantity of serum within the cranium are quite compatible with health; and in morbid states of the brain we know that, at one time, the cerebral substance, its membranes and ventricles will be nearly devoid of serum, while at another time, these parts abound with serous effusion. In accordance with the variations in the quantity of extravascular serum, there must be fluctuations in the quantity of intravascular fluid, the blood. From this conside-

> ration alone, it seems that the blood may be increased or diminished in the cranium. The increase or decrease may affect the two systems of vessels, arterial and venous, equally, or the equilibrium may be disturbed; there may be excess in either arteries or veins, without any necessary diminution in the quantity of blood contained in the other set of vessels."

Dr. B. does not believe that the contents of the cranium are entirely removed from the influence of atmospheric pressure.

> "If there were not always," he asks, "an equilibrium of pressure on the parts within and without the cranium, very serious consequences would arise at the various foramina of the skull."
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> "Atmospheric pressure is undoubtedly exerted on the blood in the vessels entering the cranium. This pressure, by a well-ascertained law in hydrostatics, must be transmitted in all directions through the fluid blood, and hence to the blood and other contents within the cranium. "If," adds Dr. B., "in the natural state of the parts, the brain is defended from atmospheric pressure, should we not expect to find the functions of that organ disturbed in some way when part of the walls of this sphere is wanting. But in children with open fontanelles, and in adults who have lost part of the bones of the cranium, we observe no peculiar disturbance of the functions of the brain from this gap in the walls of the imaginary sphere. But, lastly, the effects of gravitation on the fluid contents of the cranium, and the effects of cupping-glasses, which will often draw blood from the vessels of the dura mater, causing ecchymosis there, assure us that the cranium is not a perfect sphere in the sense in which it has been supposed."

Dr. B. next refers to the recorded experience of those most distinguished for their cultivation of morbid anatomy, who state that they have frequently discovered the vessels of the brain and its membranes "full of blood," "loaded," "turgid," gorged," "congested"—in a state of hyperæmia. The leading authorities referred to are, Morgagni, Portal, Bright, Andral, and Constadt.

In the second section of the work Dr. Burrows treats on "Vascular pressure within the cranium, and its influence on the functions of the Brain." He thinks it probable that the functions of the brain cannot be maintained in a healthy state without a certain amount of pressure upon the cerebral substance.

> "Under the ordinary conditions of health, the cerebral substance is defended by its osseous case from the influence of all variations of external mechanical pressure, and is only subjected to causes of pressure acting within the cranium. A principal and constant cause of pressure from within, is the momentum of the blood distending the arteries and veins ramifying in the membranes and substance of the brain."

Dr. B. proceeds to consider the objections to this position. 1st, that the cerebral substance is principally composed of inelastic fluids which are incompressible; and 2d, that the brain is incompressible by any such force as can be conveyed to it from the heart through the carotid and vertebral arteries. He shows, that the contents of the cranium, although very incompressible, are, nevertheless, highly elastic, and that a force is constantly operating upon the cerebral substance, through the momentum of the blood, derived partly from the contractile power of the left ventricle, and partly from the reflux of the venous blood during expiration.

The dilatation of the blood-vessels, which is the result of a distending force, must be a cause of outward pressure on the surrounding tissues in all parts of the body, but, as Dr. B. remarks, there is no organ which will so completely sustain this pressure as the brain.

> "We observe that the tissues of other organs expand and swell in proportion

to the momentum of blood in their vessels; but the substance of the brain cannot expand because it is confined within the limits of its osseous case. But when a portion of the cranium has been destroyed by accident or disease, or when a piece of the skull has been artificially removed in a living animal, and the dura mater, has thus been exposed to view, phenomena are remarked which indicate pressure on the cerebral substance by a force acting from within. With every systole of the ventricles of the heart, the surface of the dura mater rises a little; the brain appears to swell for a moment, and has a tendency to transgress the level of the bones of the cranium. The surface of the dura-mater subsides, and the brain shrinks during the period of their diastole. That such movements of the brain result from the arterial pulse, or momentum of the blood distending the arteries, may be proved by making pressure upon, and still more decidedly by putting ligatures around the arteries going to the brain."

In proof of this Dr. B. refers to the observations and experiments of Chelius, Richerand, Bichat and Ecker of Stuttgard. It has also been remarked, he adds, that when syncope occurs, this alternating motion of the brain ceases, and again returns when the heart's action is renewed.

The respiratory movements of the brain are next alluded to; these are generally considered as partly if not wholly attributable to the reflux of the blood in the veins during expiration, though Ecker attributes them in great part to the ascent of the cerebro-spinal fluid during expiration.

"The existence," says our author, "of a considerable force within the cranium, arising from vascular distension, and producing outward pressure, must, I think, be conceded. If the walls of the cranium were soft and yielding like those of the abdomen, the cranium would expand, and its capacity be increased in proportion to the increased volume of the brain at each expiration, during which that organ is the seat of an increased afflux of blood; again, when the brain was diminished in bulk during inspiration, the walls of the cranium would follow this subsidence, and its capacity would be proportionably lessened. But as the walls of the skull are rigid and inexpansive, when the brain has this recurring tendency to increase in volume, the walls around oppose the expansion, and sustain this centrifugal, or excentric pressure, which is reflected back upon the substance of the organ."

This pressure which the brain constantly sustains is equalized under the various circumstances which tend to augment or diminish it by the ample development of the venous system in the cranium and spinal canal, which affords such ready exit for redundant blood, and, very materially, according to Dr. B., by the movements of the cephalo-rachidian or cerebro-spinal fluid.

After pointing out the facts which prove the ready escape of this fluid from the lateral ventricles, through the intervention of the third and fourth ventricles, into the spinal canal, and vice versa, and of the serum of the arachnoid of the brain into the vertebral canal, Dr. B. notices the conclusions of Ecker as to the flow of the cerebro-spinal fluid to and from the brain during expiration and inspiration, and then proceeds to inquire into the true functions of this fluid. He remarks:

"This extravascular serum appears to me to be supplemental to the other contents of the cranium: it is removable by pressure or absorption, at one time giving place to an increased quantity of blood in the cranium, at another, making up for a deficiency of blood in the vessels of the head. This extravascular serum not merely acts as supplemental to the varying quantity of blood, but also to the variable quantity of nervous matter in the brain. Its quantity is in the inverse proportion to the quantity of this nervous matter. Thus in hypertrophy of the brain there is a most remarkable deficiency of serum within the cranium; the brain, its ventricles, and membranes, are so devoid of this fluid that they are almost dry: on the contrary, in atrophy of the organ, the ventricles and membranes are distended with fluid. This extravascular fluid may probably perform another office:

perhaps through this cerebro-spinal fluid a more equable pressure is diffused over the whole mass of the brain and cord; and for the reception of this regulator of pressure may be the contrivance of those cavities called ventricles, which dip into the central parts of the brain. The sac of the arachnoid may serve the same purpose."

After pointing out the manner in which disturbance of the functions of the brain is prevented when congestion of the brain is suddenly induced, or an abstraction of blood from the cranium is in any manner effected, by the escape from or flow into the brain of a portion of the cerebro-spinal fluid, Dr. B. remarks—

"When obstruction to the return of blood from the brain takes place, so that the blood becomes almost stagnant in the sinuses, that part of the force of the left ventricle, which, in the normal state of the cerebral circulation, is expended partly in propelling the blood onward through the capillaries towards the right auricle, and partly in distending the vessels through the cranium—is, under such circumstances, expended upon the interior surface of the cerebral blood-vessels. This pressure is partly sustained by the resistance of the vascular tissues, and the remainder is borne by the surrounding cerebral substance; whatever this force may be, it becomes a source of increased pressure upon the cerebral substance; and the more so, according to the pre-existing morbid states of the encephalon and its vessels. When the circulation is thus excited or obstructed, an obvious state of congestion of the integuments of the head and face is produced, and from the experiments I have detailed, it may, I think, be inferred, that a simultaneous congestion of the internal vessels of the cranium is formed.

"In previously healthy conditions of the cranium, when it contains nothing but the brain and normal quantity of serous fluid, the cerebral substance may readily accommodate itself to a temporary increase of blood in its vessels, arterial or venous, or in both, and to the consequent pressure, by expulsion of a certain amount of serum; but when the cranium contains abnormal and unremovable substances, then the brain cannot bear these accessions of vascular fullness, and consequent pressure. In those pathological states of the encephalon where there is an increase in the quantity of solid matter within the cranium and a diminution of the quantity of extravascular serum, as in hypertrophy of the brain, tumours and cysts in that organ, and in large extravasations of blood on the surface, every cause which is capable of exciting the heart's action produces a notable increased disturbance of the functions of the brain. The variable character of the symptoms of cerebral disturbance in these permanent lesions within the cranium are thus probably accounted for, by the variable vascular pressure. It seems to me probable that many permanent structural lesions within the cranium do not affect the functions of the brain by pressure, except when there is some cause in operation capable of inducing vascular congestion, or when the lesion is of a mechanical nature, or is gradually increasing.

"If the force of the contractions of the heart be diminished in these morbid states of the encephalon, there is usually a corresponding relief to the cerebral symptoms; but should the same diminution in the force of the circulation be produced in healthy states of the brain, the functions of the organ are suddenly annihilated, from insufficient vascular pressure: syncope is the result. Syncope is occasioned by insufficient vascular pressure on the brain, and not from the inadequate quantity of blood supplied to the brain and its vessels, as is commonly supposed."

The accuracy of this latter position is shown by a reference to the particular causes and circumstances by and under which syncope is the most readily induced. Thus every means by which vascular pressure on the brain is diminished to any great extent, as depressing mental emotions, sudden loss of blood, the erect posture of the body in debilitated persons, and all contrivances which diminish the momentum of the blood flowing towards the brain, will almost certainly induce syncope; which, according to Dr. B., differs from apoplexy in every respect but this one, namely, that in both there is total temporary abolition of the functions of the brain.

Dr. B. refers the more prominent of the nervous symptoms which take place in anæmia rather to insufficient vascular pressure than to an insufficient quantity of blood in the substance of the brain.

> "Simple anæmia," he remarks, "certainly does not produce that train of symptoms which is usually ascribed to a want of due supply of blood to the brain. Probably there is no condition of the brain, not even that induced by repeated hemorrhage, in which the substance of the organ is so completely anæmic as in genuine hypertrophy. In this rare cerebral affection the membranes and substance of the brain are found dry, and devoid of blood or serum; the medullary matter is as white and firm as blanc-mange, or hard-boiled white of egg. The cranium is already so completely filled by hypertrophy of the cerebral substance, that the blood is unable to make its way through the vessels; and with all this bloodlessness of the organ, we witness none of the nervous symptoms of general anæmia. On the contrary, the symptoms are rather those commonly ascribed to the effects of inordinate supply of blood to the brain. In these cases of hypertrophy of the brain the force of the heart is unimpaired, the blood is propelled with its normal force into the cerebral arteries, but it cannot make its way through the capillaries: and thus the static force of the heart is expended on the surrounding cerebral substance: so that, in anæmia of the brain from this cause, there are none of the symptoms present which accompany anæmia of the organ produced by hemorrhage, in which condition there is insufficient power of the heart to produce the amount of vascular pressure essential to the functions of the brain. Hence, we infer that the simple condition of anæmia of the brain, independent of diminished vascular pressure, is insufficient to produce the peculiar train of symptoms so often observed in general anæmia.
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> "It is in general anæmia, caused by profuse hemorrhage, that we witness the fearful catalogue of symptoms indicating disturbance of the nervous centres in their most aggravated form. In such a condition of the body, we remark, that whatever tends temporarily to assist the heart, or stimulate it to propel the blood more forcibly towards the brain, alleviates the nervous symptoms; on the contrary, whatever places the heart at greater disadvantage in propelling the blood to the brain, aggravates these nervous symptoms. The loss of consciousness in syncope, the convulsions after hemorrhage, are often immediately terminated by the horizontal posture so favourable to the momentum of the blood in the carotid arteries.
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> "From a number of curious and interesting cases illustrating the state of the nervous centres, when the system is reduced to a state of general anæmia, either by loss of blood, or other debilitating causes, the work of Dr. Marshall Hall 'On the Loss of Blood, &c.,' may be consulted with advantage. In one and all of these cases of disturbed functions of the brain, an immediate but temporary relief to the symptoms is afforded by horizontal posture, stimulants, and other means which favour the momentum of the blood through the carotid and vertebral arteries. The senses of sight and hearing are often impaired or lost during states of general anæmia, but posture alone will sometimes restore these functions of the brain."

The author adduces various examples to show the influence exercised by posture over the cerebral functions, and points out finally the effects of diminished and unequal vascular pressure upon the brain as strikingly manifested when one or both common carotids are temporarily compressed, or are suddenly and permanently closed by ligature or other means. The effects thus resulting have induced a resort to ligature of the common carotid in the treatment of some cerebral disorders, such as epilepsy, which are almost incurable by other means. After referring to the experience of Mr. Preston, Dr. Caleb Parry and Dr. Norman Chevers in relation to the success of this procedure, Dr. B. remarks, that although ligature of the common carotid is attended with risk to life in perhaps one-fourth of the cases in which it is employed, still experience has shown that where proper precautions have been taken, it is not so dangerous an operation as many suppose, and that, consequently, when in violent and hopeless cases of epilepsy and some kindred affections characterized by extreme cerebral congestion other remedies fail us, this operation may be resorted to.

This closes the first two sections of the work; both of which are replete with interest. While the facts set forth in them remove many of the errors in regard to the intercranial circulation into which most recent pathologists have been led by mistaken views, sanctioned it is true by high and imposing authority, but nevertheless clearly disproved by experiments and the facts revealed by pathological anatomy, they present also clearer and more consistent views of the nature and causes of many of the disorders of the cerebral circulation than those generally entertained. Though our extracts from this portion of Dr. B's treatise have been frequent and extended, we have scarcely done justice to the good sense and candour exhibited by the author in the prosecution of his inquiries—the clearness of his reasoning, and the aptness of his illustrations.

The third section is devoted to a consideration of apoplectic coma—or that state which consists in the suspension of the functions of the brain while those of the spinal cord remain more or less intact.

The causes of coma are analogous to those which we experimentally find are adequate to destroy the functions of the cerebro-spinal nerves in any part of their course, namely: pressure on the nervous fibres; division of the nervous substance; disorganization of the nervous matter; interrupted supply, or deficient momentum of blood in the nervous substance; the action of narcotics. Each of these causes will, Dr. B. believes, be found adequate to explain the fatal event in different cases of apoplexy; and that when we cannot discover a physical cause of pressure in fatal cases of those diseases, we shall generally be able to detect the presence, or previous operation of one of the other causes just enumerated.

Dr. B. notices the cases upon record of fatal cases of apoplexy in which, after death, no morbid appearance in the brain is discoverable. In some of these cases the absence of any unusual turgescence of the vessels of the brain, Dr. B. conceives, may be readily accounted, for from the effects of the active depletion, cold applications to the scalp, elevated position of the head, and abstraction of all stimulants practised in the treatment of the case.

It appears to him that the true explanation of the cause of the coma in the cases of so-called simple apoplexy, is to be found in the previous existence of a state of congestion of the vessels within the cranium, brought on either by determination of blood to the head, or detention of blood in that part. The fatal event in these cases he ascribes to the gradual saturation of the substance of the brain with undecarbonized blood, when the pressure has been adequate to suspend consciousness for a time, and the respiration has become altogether involuntary, slow and stertorous.

> "The apoplectic person remains in a condition analogous to that of one whose rima glottidis is constricted, or who has been suffering from apnœa for some time. The apoplectic patient then dies, not simply from pressure or lesion of the brain, but from the effects of imperfect respiration."—"Other cases of so-called simple apoplexy are probably fatal from the circulation of poisoned or narcotized blood through the nervous centres—the vital fluid being contaminated by urea, spirits, opium, or some other deleterious principle."

Serous apoplexies Dr. B. refers to congestion of the cerebral blood-vessels. After noticing the views of Portal and Abercrombie, both of whom deny that the serum in what has been termed serous apoplexy is the cause of the coma, our author remarks that,—

> "From the concurrence of all the best authorities, it would seem that the presence of serum in the brain renders that organ more susceptible, and liable to suffer from any congestion of its blood-vessels and the consequent vascular pressure, but the effused serum itself cannot be regarded as a cause of cerebral pressure adequate to the production of apoplectic coma."

Dr. B. denies, also, that, in those cases of apoplexy attended with extravasation of blood, the latter is to be viewed as, in every instance, the cause of the apoplectic coma, although it undoubtedly is of the concomitant paralysis. The coma does not always commence until some time after the extravasation has taken place, and in some cases goes off while the pressure from the extravasated blood remains, while, in other cases, an effusion of blood in much smaller quantity takes place either simultaneously with or subsequent to the occurrence of coma. Hence, if the pressure of the extravasated blood is supposed to be the immediate cause of the apoplectic coma, then, remarks Dr. B., we must account for the paradox of a small extravasation producing a coma which terminates fatally, and a large effusion of blood having no such effect.

Dr. B. details two cases of fatal apoplexy in order to show that copious extravasation of blood into the brain cannot by itself be regarded as the cause of apoplectic coma; although it is of the paralysis that is concomitant with the coma, and which remains after the coma has disappeared.

> "Unless blood be effused towards the medulla oblongata, and thus interrupt the continuity of the nervous substance between the brain and the upper part of the spinal cord, there appears to be something beyond effusion of blood required to produce fatal apoplectic coma."
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> "When cerebral hemorrhage has stopped, I suspect the blood ceases to be a real source of general pressure, although as it increases the quantity of extravascular matter in the cranium, it also offers additional resistance to the entrance of the normal quantity of blood into that cavity; hence, healthy vascular distension becomes excessive, and the symptoms of general cerebral pressure are easily developed. Thus, the compression produced by extravasation will depend more on the rapidity and situation of the effusion than on the amount. If the effusion be slow, and not near to the base, although the amount be considerable, the effects will be slight in comparison.
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> "I therefore infer, that in the larger number of cases of apoplexy accompanied with extravasation of blood, the coma is to be attributed to antecedent or co-existing cerebral congestion; while the paralysis, which is more durable, is dependent upon the limited local mischief produced by the extravasation. The close affinity between apoplexy succeeded by hemiplegia, and sudden hemiplegia unpreceded by apoplexy, has long been recognized. Each of these affections is usually connected with extravasation of blood within the cranium. In the former case, the hemorrhage is associated with vascular congestion; in the latter, the congestion is probably not present.
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> "From the foregoing inquiry into the different lesions discovered in fatal cases of apoplexy, it would appear that all the symptoms of apoplectic coma may exist without any cerebral effusion; and that effusions of serum or blood may exist to a very large extent within the cranium, and yet there shall be no apoplectic coma. Again, a person may be in a state of apoplectic coma for many hours, entirely recover from the coma, but shortly afterwards die, when effusion of serum or blood will be discovered in the brain." "Hence, it appears, that apoplectic coma may exist without effusion, and cerebral effusions to a great extent may exist without coma. This supports the opinion already expressed, that in a vast majority of cases of apoplexy, the coma is attributable to the pressure induced by vascular congestion. It is not meant to assert that other causes may not annihilate the functions of the brain, and cause coma, as, for example, the circulation of

venous blood through the organ, but the foregoing remarks apply to the coma of apoplexy."

Dr. B. next inquires why that apoplectic coma is not produced by those frequently recurring causes of determination of blood to the brain, such as violent exercise, strong mental emotions, and intemperance. He refers the protection of the brain from pressure under ordinary circumstances of increased determination to its vessels, to the course of the arteries through tortuous canals of bone, and the anatomical arrangement of the sinuses of the dura mater. Any sudden increase in the momentum of the blood flowing to the cranium being diminished by the first, while the second give a free exit to the blood from the brain without being liable to have their areas either increased or diminished in any considerable degree,—and in addition to these means of protection, Dr. B. considers that the existence of the extravascular serum within the cranium, by its capability of flowing from the cavity of the skull into the spinal canal, affords an additional protection to the brain against the effects of any sudden congestion of its blood-vessels.

The views of Dr. B. in relation to the immediate cause of apoplectic coma are of a highly interesting character; they are, it is true, in direct opposition to those advocated by some of the most distinguished of our modern medical authorities,—but a careful examination of the facts and arguments upon which they are based, will, we are persuaded, be sufficient to convince every one of their correctness. We believe that the errors into which modern pathologists have fallen in regard to the true character of apoplexy, have resulted from misconceptions as to the peculiarities of the circulation within the cranium, on the one hand, and their assuming, on the other, as correct, the results deduced from experiments undertaken to prove that under no circumstances, so long as the bones of the skull remained entire, no material change can take place in the absolute quantity of blood circulating in the vessels of the brain. Dr. B. has, however, very clearly shown that the amount of blood in the intercranial vessels, both arteries and veins, may be augmented or diminished by a variety of causes, and that this augmentation or diminution, when carried to a certain extent, is invariably productive of a disturbance of the functions of the brain—the pressure resulting from over distension giving rise to a state of coma—and the diminution of this pressure, from a deficiency of vascular distension within the cranium, producing a sense of exhaustion or complete syncope. He has likewise, to make use of the words of Dr. Watson, (*Lectures on the Practice of Physic,*) "most convincingly shown that the conclusions of Dr. Kellie and others (drawn from experiments performed by Dr. K.) were erroneous. The theory which is thus demolished," continues Dr. Watson, "involved probably more than one erroneous assumption. By this refutation of a prevalent error, not unlikely to warp or mislead our practice in some cerebral disorders, the science of medicine has derived an essential service."

In the fourth section Dr. B. considers the connection of apoplexy and hemiplegia with diseases of the heart;—the influence of lesions of the heart on the cerebral circulation, and the relative frequency of different cardiac lesions in apoplexy and hemiplegia.

Dr. B. believes that there is a much greater dependence of structural and functional disorders of the brain upon diseases of the heart, both acute and chronic, than is commonly supposed;—that hypertrophy, dilatation, and valvular diseases of the central organ of the circulation, which are such constant causes of congestion in other parts of the body, will be frequently found to co-exist with similar conditions of the vessels within the cranium; and that in cases of effusion of serum, or extravasation of blood within the cranium, we shall find, not unfrequently, those same lesions of the heart which are so repeatedly remarked to be coincident with dropsies and hemorrhages in other parts of the body.

From various sources Dr. B. has formed the following table, which gives an analysis of 132 cases of apoplexy and sudden hemiplegia with reference to the co-existence of cardiac disease.

Authors.	Cases.	Diseased Heart.	Per cent
Andral	25	15	60
Clendinning	28	15	53.5
Hope	39	27	69.4
Burrows (case books)	34	23	67.6
Guillemin	6	4	66.6
Total	132	84	63.6

"The inference from the foregoing calculation," remarks our author, "is that in any given number of cases of apoplexy and sudden hemiplegia, no less than three-fifths will present unequivocal signs of cardiac disease, either hypertrophy, dilatation, valvular disease, or some combination of these lesions. This proportion proves the frequency is much greater than is commonly supposed, even by those who admit the occasional influence of cardiac disease in the production of apoplexy and hemiplegia. On the other hand, it is fair to state, that M. Rochoux has come to a different conclusion. After citing the opinions of Corvisart, Bricheteau, Ravier, and Lallemand, in favour of the connection between apoplexy and hypertrophy of the heart, M. Rochoux states, that out of forty-two cases of apoplexy, which he had examined prior to 1818, three only presented hypertrophy of the heart. In reply to this calculation. I would state, that upon referring to the accounts of thirty cases of apoplexy observed by M. Rochoux, and detailed in his work, it appears that the state of the heart was examined into only fourteen times; and that in four of these serious changes in the muscular or valvular structure of that organ were discovered. Thus, if the simple statement of M. Rochoux be taken, it would appear that in cases of apoplexy the heart was found hypertrophied in the proportion of 3 : 42, or 1 to 14; whereas, if the more correct calculation be made, the proportion of diseased hearts in cases of apoplexy examined by M. Rochoux, ascends to 4 : 14. Although that average, obtained from the analysis of the cases reported by M. Rochoux, is less than that given in the foregoing table, still it must be borne in mind, that lesions of the heart were not so easily appreciated prior to 1818, as at the present time. It is necessary, also, to remark, that this author restricts the term apoplexy to those cases where there is rupture of the proper tissue of the brain followed by hemorrhage; and that he excludes from this category those cases described by Abercrombie and others, under the title of 'simple congestive apoplexy.' To such varieties of the disorder he applies the term 'coup de sang,' and admits that the state of the heart exerts a very great influence in the production of congestion of the blood-vessels of the brain, although very little upon genuine apoplexy—i. e. cerebral hemorrhage. If this admission be taken into the calculation, it is probable that the average obtained from M. Rochoux's cases would not have materially differed from that given in the table."

Dr. B. examines next, the question as to which of the lesions of the heart is most likely to give rise to apoplexies and sudden hemiplegia; and from the result of his observations, concludes that hypertrophy with valvular lesions, or these affections of the heart combined with disease of the cerebral arteries, are, one or the other, most frequently found in fatal cases of apoplexy. To show the relative frequency of these several cardiac lesions in cases of apoplexy and sudden hemiplegia, Dr. B. gives in the following table the analysis of 25 cases recorded by Andral, and 34 cases taken from his own case books.

	No. of Cases.	Heart Diseased.	Hypertrophy with Valvular disease.	Hypertrophy, (simple.)	Valvular Disease.
Andral	25	15	9	4	2
Burrows	34	23*	10	6	6
Total	59	38	19	10	8

In regard to the period of life most prone to apoplexy and hemiplegia, Dr. B., after deducing various calculations drawn from different sources, and presented in a tabular form, remarks that

> "The first general inference from these tables is, that the relative frequency of apoplexy steadily increases from 20 to 80 years of age; and the second, which is more remarkable, is, that the actual number of apoplectic cases increases in each successive decennial period upwards, from 20 to 70 years of age, while the numbers living gradually diminish. The original statistical researches of Dr. Clendenning upon the heart and other viscera, forming the Croonian lectures for 1838, will afford some interesting points for further comparison with the results of the previous table. This physician ascertained, by a series of extended observations, that the force of nutrition of the heart increases as life advances. This is proved by the increasing average weight of the heart, so that in estimating hypertrophy of the heart, some allowance must always be made for the age of the individual. From this writer we learn that hypertrophy of the heart is a change concomitant to that period of life when apoplexy is most prevalent.
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> "Hence, then, the frequency of apoplexy in advanced periods of life, the usual co-existence of hypertrophy of the heart at the same period, and the ascertained tendency of cardiac disease to produce hypertrophy of the brain, are facts which, when taken in conjunction, confirm the conclusions arrived at in the previous part of the section, namely, that the coincidence between apoplexy and diseases of the heart is something more than accidental."

In the fifth section Dr. B. presents some observations on the treatment of apoplexy and hemiplegia. He points out the importance of posture in emptying the vessels of the head both external and internal, and the necessity of attention to the state of the heart, before the question of large abstraction of blood is decided upon.

When no cardiac disease is discoverable, or only simple hypertrophy without notable valvular disease, depletion both general or local, may, according to Dr. B., be carried on so far as the cerebral symptoms appear to call for that kind of relief; but if, upon examination, the existence of valvular disease to the extent of obstructing the circulation through the cavities of the heart be detected, the pulse will be a most deceptive guide as to the propriety or impropriety of abstraction of blood. If it be the mitral valve which is principally implicated, allowing of regurgitation from the left ventricle, the small and irregular pulse would probably dissuade from that free abstraction of blood which the cerebral symptoms might require; if the aortic valves be found diseased to the extent of not only obstructing the onward current of blood, but also of allowing regurgitation into the ventricles, during its diastole, there will probably be associated with this lesion hypertrophy of the left ventricle.

> "Here will be observed a full and vibrating or thrilling pulse, but a pulse of increased action without real power, and hence a deceptive pulse; and one which if it be regarded without reference to the structural changes of the heart, would invite to a more copious abstraction of blood than was called for by the general

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* In one case there was simple dilatation of the cavities.

symptoms. In each of these last-mentioned cases greater relief to the symptoms will be obtained by a free local abstraction of blood from the vicinity of the heart (either by cupping from beneath the left mamma, or between the left scapula and spine), than by a much larger depletion by venesection."

When with the indications of serious valvular disease of the heart there is well-grounded suspicion that an osseous deposit has occurred about the valves of the left ventricle, in the coats of the ascending aorta, and, in all probability, in the tunics of the arteries within the cranium, in such cases an accidental congestion may have been followed by extravasation of blood, and thus have arisen the most common symptoms of apoplexy. Here the copious abstraction of blood should be abstained from, notwithstanding the fullness and hardness of the radial pulse.

In cases of apoplexy and hemiplegia complicated with dilatation of the cavities of the heart and extensive emphysema of the lungs, the appearances of extreme congestion and dyspnœa might tempt a resort to large depletion, and thus the very conditions of the heart which have induced the cerebral congestion and apoplectic symptoms would be aggravated. In these cases Dr. B. suggests cupping glasses to the nape of the neck or between the scapulæ, with the internal administration of stimulating diuretics, diffusible stimulants, and the application of rubefacients to the sternum.

"In cases of apoplexy, about two or three days after emergence from the coma, and recovery from the depletion practised during the fits, we often observe the patient's face to become flushed, the scalp hot, a frowning or knitting of the brows, slight strabismus, and complaint of pain on one side the head. This pain is usually referred to the temporal, parietal, or occipital region opposite to the paralyzed limbs,—and if the patient be deprived of the power of expressing his sensations, his uneasiness is often indicated by the occasional movement of the sound hand to the forehead." "At the same time, the circulation, which had been much enfeebled by the remedies employed during the fit, becomes more active,—the patient is thirsty, and is sometimes troubled with an oppressive heat of the surface of the body."

"These symptoms, which are indicative of inflammatory action commencing around the clot of blood in the brain, may generally," according to our author, "be controlled in a most striking manner by small local depletion from the temple or mastoid process on the side opposite to the paralysis,—by the application of cold to the head, and by the administration of purgatives, by restricted diet, and by extreme quiet in the sick room."

When the heat of the head is diminished, he has found a blister applied near the occiput to afford great relief to the oppressive headache. When the patient is not of a very advanced age, nor extremely exhausted by depletion, great benefit, Dr. B. observes, will be derived from the administration of one grain of calomel every six hours; allowing it to act as a purgative, or to slightly affect the gums.

At the same stage of the disease the paralyzed limbs are not uncommonly affected with involuntary movements which usually consist of spasmodic contractions, either tonic or clonic. The patient will now most probably complain of severe pains in the palsied limbs, and of burning heat in them, so that he will long to plunge them into cold water; the integuments of these limbs often feel hot and are red and swollen.

"These wearing pains," remarks Dr. B., "are not confined to the integuments, but appear to pervade the deeper seated parts, so that the periosteum of the bone of a palsied limb will become swollen and painful. In some cases these pains have appeared to be attributable to the continuance of irritation from the clot upon the surrounding cerebral substance; in other cases there has been no evidence of cerebral excitement; but this painful state of the limbs seemed to depend upon returning functions in the nerves, and partly upon the capillary circulation in the tissues of the limb not being duly regulated by the nervous system. These pains in palsied limbs are very analogous to those which are experienced in a part when the circulation and animal temperature are returning to it after it has been benumbed by cold."

In this condition of the limbs the remedies which Dr. B. has found most serviceable, are slight local depletions from the head, when there has been any remaining symptom of cerebral irritation, combined with the application of evaporating lotions, either tepid or cold, to the affected limbs. In a few cases, unattended with headache, flushing, heat of scalp, and other similar symptoms, he has found marked relief to follow the application of leeches, and evaporating lotions or poultices to the painful limb. In some cases the redness and heat subside, but the neuralgia remains, and after continuing weeks or months gradually disappears.

"A change in the condition of the soft parts of the paralyzed limbs now succeeds; they shrivel and waste away,—the limb becomes more or less contracted in different cases; any attempt at extension causes much pain; the limb looses its temperature readily, if exposed uncovered to the atmosphere, and when confined in bed it is often found bedewed with a warm, clammy perspiration. There is very little hope of any restoration of muscular power when such changes have taken place,—but much may be done to prevent such limbs getting worse."

Dr. B. strongly cautions against allowing patients, recovering from an attack of apoplexy, to rise too soon from bed, or to take too much freedom in exercise, mental occupation, and diet. By a neglect of this precaution a fresh extravasation of blood in the brain may be induced, productive of irreparable mischief—the head symptoms may be renewed with subsequent disorganization of the cerebral substance, or the supervention of inflammation of the brain and its membranes may be caused.

Three or four cases are detailed illustrative of the bad effects of premature exertions after apoplexy.

"When," Dr. B. remarks, "sufficient time has elapsed from the fit to allow of a restoration of the injured cerebral substance to its healthy condition, it becomes of importance to excite the suspended functions of the nerves in the paralyzed limbs. To effect this object, the application of blisters or frictions with stimulating liniments over the affected limbs, particularly in the course of the great nervous trunks, are sometimes attended with good results. Such measures, if not directly beneficial to the palsied limbs, sustain the confidence and hopes of the patient during his tedious convalescence."

From the effects of electro-galvanism Dr. B. has not witnessed any decided good effects even when used under the most favourable circumstances. His opinion of strychnia is even less favourable than that which he has expressed respecting electricity. In some cases, he states, it does much harm by aggravating the wearing pains in the affected limbs to a much more acute suffering. Regular frictions over the surface of the affected limbs and well-devised exercise of the muscles he recommends as the best means of exciting a more active circulation in the wasted muscles and nerves of the limbs, and of renovating and invigorating the proper functions of their different tissues.

In cases of paralysis, in which there has been some idiopathic affection of the encephalon, a seton or issue at the nape of the neck may, he conceives, retard the unfavourable progress of the disease; but if, on the other hand—

"The cerebral congestion is attributable to some of those serious lesions of the heart alluded to in the foregoing sections," then he considers "counter-irritation at such a distance from the affected organ not only useless, but sometimes positively injurious."

Section the sixth treats of the influence of diseases of the heart in exciting functional disturbance of the brain. Dr. B. presents the detail of a number of cases of severe epistaxis occurring in chronic cardiac diseases; of epistaxis and serous effusion alternating in cardiac diseases; and cases of epistaxis and apoplexy in cardiac diseases; these cases strongly corroborate the necessity of examining into the state of the heart whenever epistaxis occurs unexpectedly in adults. This hemorrhage, Dr. B. believes, may often be considered as strictly pathognomonic of an obstructed circulation through the heart, as hemoptysis is symptomatic of tuberculated lungs, or intestinal hemorrhage of an indurated liver.

Dr. B. notices next a class of cases marked by a variety of cerebral symptoms, of which the most prominent is *headache*, and where the primary disease, or cause of these symptoms, is hypertrophy of the heart. He refers also to the fact that mental disturbance is often produced by chronic cardiac disease.

The whole section is replete with useful practical hints calculated to lead to the better understanding of the pathology, and the more successful treatment of a very common class of obscure or intractable head affections.

The seventh and last section is devoted to a consideration of affections of the brain and spinal cord depending on acute diseases of the heart. This subject is illustrated by the details of sixteen cases of acute cardiac disease, some of which were marked with all the usual symptoms of inflammation of the brain and its membranes; others simulating mania and dementia; others characterized by apoplectic and epileptic symptoms; others with well-marked symptoms of tetanus and trismus, and others, again, accompanied by symptoms of aggravated chorea and hysteria.

After an analysis of these cases, Dr. B. remarks—

> "From the foregoing analysis it is evident, that an early diagnosis of the cardiac affection is a very important element to ensure a successful termination to the case. It also appears that the plan of treatment, which alone was attended with success, consisted of a combination of general and local depletion, with the application of blisters to the cardiac region, and the free use of calomel combined with opium."

Dr. B. is strongly in favour of depletion from the region of the heart by cupping glasses applied between the base of the left scapula and the spine, or by leeches applied near the left mamma, in cases of acute rheumatic pericarditis; after which, there is no remedy upon which he places more reliance than a blister over the cardiac region. In all cases of pericarditis, excepting in patients affected with tubercular disease of the lungs, or in the very anæmic or cachectic, he employs mercurial preparations as freely as in acute inflammations of other parts. He administers a few large doses of calomel, varying from five to ten grains, combined with a grain of opium, and then continues half the dose of the same combination at moderate intervals, until the urgent symptoms abate, or the mouth becomes distinctly affected by the mercury. He sometimes, although rarely, orders mercurial inunction, together with the internal administration of the calomel.

We have met with few works which have interested us more than the one before us, and we strongly recommend it to our readers as one replete with hints calculated to lead to still further advances in the pathology, diagnosis, and treatment of diseases of the brain, as well as of a large class of affections vaguely described as nervous or spinal.

D. F. C.